REMARKS

This amendment is responsive to the Office Action dated May 2, 2007. Applicant has amended claims 10, 11, 17, 25, 27, 30, 32, 34, 35, 37, and 40-42 and cancelled claim 31. Claims 1-30 and 32-42 are pending.

Oath/Declaration

In the Office Action, the Examiner stated that the oath or declaration is defective because it does not identify the citizenship of each inventor. Applicant acknowledges the defect and will address the declaration in a separate communication.

Claims Objections

In the Office Action, the Examiner objected to claim 40 because of informalities. Applicant has amended claim 40 to correct the informalities.

Claim Rejection Under 35 U.S.C. § 101

In the Office Action, the Examiner rejected claim 42 under 35 U.S.C. 101, because the claimed invention is directed to non-statutory subject matter. Specifically, the Examiner objected to claim 40 because the preamble lacks the proper form for a computer program product and there is not a process, machine, manufacture, or composition of matter. Applicant has amended claim 40 as suggested by the Examiner.

Claim Rejection Under 35 U.S.C. § 112

In the Office Action, the Examiner rejected claims 10, 11 and 34 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant has amended claims 10, 11, and 34 for purposes of clarification. Applicant submits that claims, as amended, particularly point out and distinctly claim the subject matter, as required by 35 U.S.C. 112, second paragraph.

Claim Rejection Under 35 U.S.C. § 103

Independent claims 1, 17, 30, and 42

In the Office Action, the Examiner rejected claims 1, 2, 4, 11-14, 17-18, 21, 23, 24, 30-33 and 40-42 under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (US 2002/0191703), hereafter referred to as "Ling," in view of Onggosanusi et al. (US 2002-0114269), hereafter referred to as "Onggosanusi ." Applicant respectfully traverses these rejections. The applied references, whether taken alone or in combination, fail to disclose or suggest the inventions defined by Applicant's claims, and provide not teaching that would have suggested the desirability of modification to arrive at the claimed invention.

As a preliminary comment, Applicant has amended independent claim 30 to recite similar features required in independent claims 1, 17, and 42. Specifically, Applicant has amended claim 30 to require receiving channel state information for a wireless communication system, adaptively selecting a signal constellation from a set of constellations based on the channel state information, mapping information bits of an outbound data stream to symbols drawn from the selected constellation to produce a stream of symbols, applying a beamformer to the stream of symbols to generate a plurality of coded data streams, and outputting waveforms from a plurality of transmit antennas in accordance with the plurality of coded data streams. Consequently, Applicant's independent claims 1, 17, 30, and 42 require the same features.

The Ling and Onggosannusi references, whether taken alone or in combination fail to disclose or suggest a constellation selector that adaptively selects a signal constellation from a set of constellations based on channel state information for a wireless communication channel, wherein the constellation selector maps information bits of an outbound data stream to symbols drawn from the selected constellation to produce a stream of symbols, a beamformer that generates a plurality of coded data streams from the stream of symbols, and a plurality of transmit antennas that output waveforms in accordance with the plurality of coded data streams, as recited by Applicant's claim 1.

In rejecting claim 1, the Examiner cited Figure 2A of Ling as teaching a constellation selector that adaptively selects a signal constellation from a set of constellations based on channel state information for a wireless communication channel, wherein the constellation selector maps information bits of an outbound data stream to symbols drawn from the selected

constellation to produce a stream of symbols, and a plurality of transmit antennas that output waveforms in accordance with the plurality of coded data streams. The Examiner also cited Figure 2A of Ling as teaching a multiple input, multiple output (MIMO) processor that generates a plurality of coded data streams from the stream of symbols. Figure 2A and the text cited by the Examiner in paragraph [0041] show a MIMO processor 120a that includes a demultiplexer 214. Demultiplexer 214 demultiplexes the modulation symbols received from a transmit data processor 114a into a number of streams of modulation symbols. Specifically, demultiplexer 214 demultiplexes a stream of modulation symbols to form one stream for each transmit antenna. Thus, Ling describes a MIMO transmitter that codes data for each transmission channel based on channel state information provided by a receiver.

The Examiner recognized that Ling does not expressly teach a beamformer. In his analysis, however, the Examiner stated that Onggosannusi teaches a single stream transmitter module 18 coupled to channel state processing unit 16, which additionally incorporates sub-channel selection circuitry 24 containing beamformer weight determiner 30. The Examiner further stated, referencing paragraphs [0043] and [0045 and Figures 1 and 2], that the set of beamformer weights are passed onto the single stream transmitter module 18 and the modulated signal stream is weighted by the corresponding value from the weight vector. However, Onggosannusi makes no mention nor describes any mechanism for implementing **a beamformer capable of generating a plurality of coded data streams from the stream of symbols**. Instead, the text cited by the Examiner describes a beamformer weight determiner 30 for aiding the process of transmitting a single stream of data via a plurality of antennas.

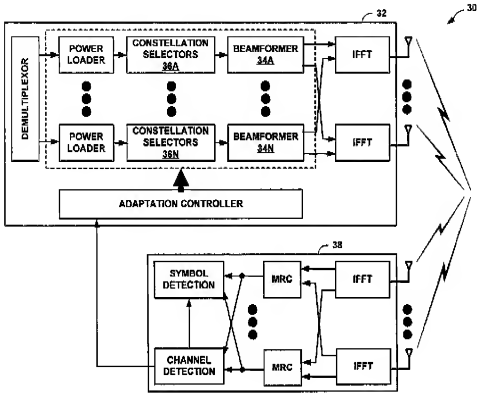
Figures 1 and 2 of Onggosannusi depict a transmitter 10 that includes a channel state processing unit 16 and a single stream transmitter module 18 coupled to the channel state processing unit 16. The channel state processing unit 16 includes the sub-channel selection circuitry 24 containing a frequency index selector 28 and beamformer weight determiner 30. The frequency selector 28 and beamformer weight determiner 30 pass a frequency index and beamformer weights to the single stream transmitter module 18 to select subchannels for transmitting data.

The single stream transmitter module 18 receives a stream of data via a single input and outputs a single modulated signal stream. The modulated signal stream is coupled to each of the

transmit antennas after being weighted by the corresponding weight vectors supplied by beamformer weight determiner 30. Figure 2 clearly shows the stream of data 12 applied to the input of single stream transmitter module 18 and signal modulator 38 of single stream transmitter module 18 producing the modulated signal stream. Thus, Onggosannusi merely describes generating one or more beamformer weights that are applied **to the same signal stream** and applying corresponding weighted signal streams to each of the transmit antennas. Coupling the same signal stream to each antenna is distinctly different than generating a plurality of coded data streams from a stream of symbols and outputting waveforms in accordance with the plurality of coded data streams over a plurality of transmit antennas.

In contrast, independent claim 1 recites a beamformer that generates **a plurality of coded data streams from the stream of symbols.** In other words, based on a single input stream of symbols, Applicant's claimed beamformer outputs a plurality of coded data streams. For this reason, the present application describes an exemplary embodiment in which each beamformer generates two different coded data streams from a single stream of symbols. That is, each beamformer is as a "two-dimensional (2D) beamformer." These multiple streams are then provided to different antennas. As an additional aid, Applicant refers the Examiner to the discussion of dependent claim 10 below. Neither Onggosannusi nor any of the references, alone or in combination, describe a multi-dimensional beamformer that produces a plurality of coded data streams from a single stream of symbols, as recited by claim 1, and allocates a portion of each of the encoded data streams to a different antenna in the manner recited by claim 10.

FIG. 12 of the present application illustrates an exemplary embodiment of the claimed invention, and is reproduced below for the Examiner's convenience.



As shown in FIG. 12, each of beamformers 34A-N generates a plurality of coded data streams from a stream of symbols. As an example, a 2D beamformer may use the Alamouti code to generate two data streams, $\bar{s}_1(n)$ and $\bar{s}_2(n)$, from the original symbol stream, s(n), according to equation (8) which is reproduced below for the Examiner's convenience. Alamouti's code is well known as achieving full rate by transmitting two symbols over two time slots. During the first time slot a first symbol and a complex conjugate of the second symbol are transmitted using respective transmit antennas. During the subsequent time slot, the second symbol and the complex conjugate of the first symbol are transmitted using respective transmit antennas. Thus, $\bar{s}_1(n)$ and $\bar{s}_2(n)$ include different data and are characterized as different steams of coded data.

$$\begin{bmatrix} \bar{s}_1(2n) & \bar{s}_1(2n+1) \\ \bar{s}_2(2n) & \bar{s}_2(2n+1) \end{bmatrix} = \begin{bmatrix} s(2n) & -s^*(2n+1) \\ s(2n+1) & s^*(2n) \end{bmatrix}.$$

In contrast, Onggosannusi describes transmitting **the same modulated signal over each of a plurality of antennas**. In Onggozannusi, a single, one-dimensional beamformer that applies

beamformer weights to the modulated signal for the corresponding antenna. Each modulated signal stream includes the same data for each time slot. To be clear, the beamformer operates on a single stream of symbols to compute weightings. In the case where there are multiple transmitter modules, the weights are applied to different data streams. Even in this case, the beamformer does not produce multiple encoded data streams from a single input data stream, as recited by Applicant's claims. In other words, the Onggosannusi approach requires multiple input symbol streams in order to produce multiple encoded data streams. Each single stream transmission module generates a corresponding modulated signal for transmission that is applied to each of the transmit antennas and weighted using corresponding beamformer weights. Modulated signals on the same transmit antenna are summed together and the resulting signal is transmitted via the antenna. Consequently, neither Ling nor Onggosannusi, whether taken alone or in combination, provides any teaching that would have suggested modification of the wireless communication system in Ling to include a beamformer capable generating a plurality of coded data streams from a stream of symbols, as required by Applicant's claim 1.

It is well established in order to establish a *prima facie* case of obviousness, the prior art must provide a "teaching or suggestion to one of ordinary skill in the art to make the changes that would produce" the claimed invention.[1] A prima facie case of obviousness is established only when this burden is met. In the present case, Ling and Onggosannusi fail to provide the necessary teaching or suggestion to render the invention of Applicant's independent claim 1 obvious. Neither Ling nor Onggosannusi provides any teaching that would have suggested modification of the wireless communication system in Ling to include a beamformer that generates a plurality of coded data streams from a stream of symbols. First, Applicant points out that it is clear from the disclosures of Ling and Onggosannusi in view of the previous remarks that neither Kraft nor Onggosannusi in no way contemplates a 2D beamformer, i.e., a beamformer that generates a plurality of coded data streams from a stream of symbols, in any way. Moreover, Onggosannusi does not provide any teaching that would overcome the deficiencies of Ling with respect to the requirements of Applicants independent claims discussed above.

[1] *In re Chu*, 36 USPQ2d 1089, 1094 (Fed. Cir. 1995).

For at least the reasons identified above, the Ling and Onggosannusi references do not support a prima facie case for obviousness with respect to Applicant's claim 1 under 35 U.S.C. § 103(a). Withdrawal of this rejection is requested. In the Office Action, the Examiner rejected independent claims 17, 30 and 42 using the same rationale as claim 1. Accordingly, Ling in view of Onggosannusi does not support a prima facie case for obviousness with respect to Applicant's claims 1, 17, 30, and 42 under 35 U.S.C. § 103(a). Withdrawal of this rejection is requested, for at least the reasons stated above.

Claims 2, 4, 11-14, 18, 21, 23, 24, 32, 33, 40, and 41 depend from allowable claims 1, 17, 30, and 42 and, for at least the reasons described above, are allowable in view of the cited references. In view of the fundamental differences identified above, Applicant reserves further comment concerning the teachings of the cited references relative to additional requirements set forth in the dependent claims, but neither admits nor acquiesces in the propriety of the application of the cited references to such claims.

Claim 3

In the Office Action, the Examiner rejected claim 3 under 35 U.S.C. 103(a) as being unpatentable over the combination of Ling et al. (US 2002/0191703) in view of Onggosanusi et al. (US 2002-0114269) as applied to claim 1 above, and further in view of Visotsky et al. (NPL – *Space-Time Transmit Precoding with Imperfect Feedback*, 2001), hereafter referred to as "Visotsky." Applicant respectfully traverses the rejection. First, Applicant points out that it is clear from the disclosures of Ling and Onggosannusi in view of the previous remarks, that Ling and Onggosannusi, whether taken alone or in combination, in no way contemplate a beamformer that generates a plurality of coded data streams from a stream of symbols. Moreover, Visotsky provides no teaching to overcome the above deficiencies. The applied references fail to disclose or suggest the invention defined by Applicant's claim 3, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

Claims 5- 8, 10, 16, 25-27, 29, 34-36, 38, and 39

In the Office Action, the Examiner rejected claims 5-8, 10, 16, 25, 26, 27, 29, 34-36 and 38-39 under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (US 2002/0191703) in view

of Onggosanusi et al. (US 2002-0114269) as applied to claim 1 above, and further in view of Dabak et al. (US 6,594,473), hereafter referred to as "Dabak." Applicant respectfully traverses the rejection to the extent such rejection may be considered applicable to claims 5-10, 16, 25-27, 29, 34-36, 38, and 39.

First, Applicant points out that it is clear from the disclosures of Ling and Onggosannusi in view of the previous remarks, that Ling and Onggosannusi, whether taken alone or in combination, in no way contemplate a beamformer that generates **a plurality of coded data streams from a stream of symbols.** Moreover, Dabak provides no teaching to overcome the above deficiencies.

Second, Applicant refers the Examiner to claim 10 that requires that *the beamformer applies an antenna weighting vector to the space-time coded data streams to allocate a portion of each of the space-time coded data streams to each of the output antennas.* **Neither Onggosannusi nor any of the references, alone or in combination, describe a multi-dimensional beamformer that produces a plurality of coded data streams and allocates a portion of each of the streams to a different antenna in the manner recited by claim 10. In Onggosannusi, a one-dimensional beam former is used without any suggestion of a beamformer capable of producing a plurality of coded data streams from a single data stream. Nor does Onggosannusi describe a beamformer capable of allocating a portion of each of the multiple streams to different antennas.**

The applied references fail to disclose or suggest the invention defined by Applicant's claims 5-8, 10, 16, 25-27, 29, 34-36, 38, and 39, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

Claims 9 and 37

In the Office Action, the Examiner rejected claims 9 and 37 under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (US 2002/0191703) in view of Onggosanusi et al. (US 2002-0114269) and Dabak et al. (US 6,594,473) as applied to claims 8 and 35 above, and further in view of Sampath (US 2003/0043929), hereafter referred to as "Sampath." Applicant respectfully traverses the rejection to the extent such rejection may be considered applicable to claims 9 and

37. First, Applicant points out that it is clear from the disclosures of Ling and Onggosannusi in view of the previous remarks, that Ling and Onggosannusi, whether taken alone or in combination, in no way contemplate a beamformer that generates a plurality of coded data streams from a stream of symbols. Moreover, Sampath provides no teaching to overcome the above deficiencies. The applied references fail to disclose or suggest the invention defined by Applicant's claims 9 and 37, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

Claims 15 and 28

In the Office Action, the Examiner rejected claims 15 and 28 under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (US 2002/0191703) in view of Onggosanusi et al. (US 2002-0114269) as applied to claims 1 and 17 above, and further in view of Hockley, Jr. et al. (US 2004/0008138), hereafter referred to as "Hockely, Jr.." Applicant respectfully traverses the rejection to the extent such rejection may be considered applicable to claims 15 and 28. First, Applicant points out that it is clear from the disclosures of Ling and Onggosannusi in view of the previous remarks, that Ling and Onggosannusi, whether taken alone or in combination, in no way contemplate a beamformer that generates a plurality of coded data streams from a stream of symbols. Moreover, Hockley Jr. provides no teaching to overcome the above deficiencies. The applied references fail to disclose or suggest the invention defined by Applicant's claims 15 and 28, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

Claims 19 and 20

In the Office Action, the Examiner rejected claims 19-20 under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (US 2002/0191703) in view of Onggosanusi et al. (US 2002-0114269) as applied to claim 17 above, and further in view of Heo et al. (US 2003/0103481), hereafter referred to as "Heo." Applicant respectfully traverses the rejection to the extent such rejection may be considered applicable to claims 19 and 20. First, Applicant points out that it is clear from the disclosures of Ling and Onggosannusi in view of the previous remarks, that Ling and Onggosannusi, whether taken alone or in combination, in no way contemplate a beamformer

that generates a plurality of coded data streams from a stream of symbols. Moreover, Heo provides no teaching to overcome the above deficiencies. The applied references fail to disclose or suggest the invention defined by Applicant's claims 19 and 20, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

Claim 22

In the Office Action, the Examiner rejected claim 22 under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (US 2002/0191703) in view of Onggosanusi et al. (US 2002-0114269) as applied to claim 21 above, and further in view of Hughes-Hartogs (US 4,731,816), hereafter referred to as "Hughes-Hartogs." Applicant respectfully traverses the rejection to the extent such rejection may be considered applicable to claim 22. First, Applicant points out that it is clear from the disclosures of Ling and Onggosannusi in view of the previous remarks, that Ling and Onggosannusi, whether taken alone or in combination, in no way contemplate a beamformer that generates a plurality of coded data streams from a stream of symbols. Moreover, Hughes-Hartogs provides no teaching to overcome the above deficiencies. The applied references fail to disclose or suggest the invention defined by Applicant's claims 22, and provide no teaching that would have suggested the desirability of modification to arrive at the claimed invention.

CONCLUSION

All claims in this application are in condition for allowance. Applicant respectfully requests reconsideration and prompt allowance of all pending claims. Please charge any additional fees or credit any overpayment to deposit account number 50-1778. The Examiner is invited to telephone the below-signed attorney to discuss this application.

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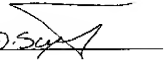

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